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Proceedings of the Regional Peer Review on the Newfoundland and Labrador Snow Crab Assessment

February 24-26, 2015
St. John's, NL

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

A regional peer review process for Snow Crab (*Chionoecetes opilio*) in Newfoundland and Labrador was held February 24-26, 2015, in St. John's, NL. The purpose was to assess the status of the Snow Crab resource in Northwest Atlantic Fisheries Organization (NAFO) Divisions (Divs.) 2HJ3KLNO4R and Subdivision (Subdiv.) 3Ps.

Participation included representatives from Fisheries and Oceans Canada (DFO) Science and Fisheries Management Branches (NL Region), the fishing industry, the Provincial Department of Fisheries and Aquaculture, Academia, Aboriginal groups, and other invited experts.

Detailed rapporteur's notes of the discussion that followed each presentation were produced. This Proceedings Report includes an abstract and a summary of meeting discussions, as well as a list of research recommendations.

Compte rendu de l'examen régional par des pairs sur l'Évaluation du crabe des neiges de Terre-Neuve-et-Labrador

SOMMAIRE

Un processus régional d'examen par les pairs du crabe des neiges (*Chionoecetes opilio*) à Terre-Neuve-et-Labrador a eu lieu du 24 au 26 février 2015 à St. John's, à Terre-Neuve-et-Labrador. Son objectif était d'évaluer l'état des ressources de crabe des neiges dans les divisions 2HJ3KLNO4R et la sous-division 3Ps de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO).

Les participants comprenaient des représentants de la Direction des sciences et de la Direction de la gestion des pêches de Pêches et Océans Canada (MPO) (région de T.-N.-L.), de l'industrie de la pêche, du ministère provincial des Pêches et de l'Aquaculture, du milieu universitaire, des groupes autochtones, et d'autres experts invités.

Les notes détaillées du rapporteur des discussions qui ont suivi chaque présentation ont été produites. Ce compte rendu comprend un résumé et un sommaire des discussions de réunion, de même qu'une liste des recommandations relatives à la recherche.

INTRODUCTION

A regional peer review process for Snow Crab (*Chionoecetes opilio*) in Newfoundland and Labrador was held February 24-26, 2015, in St. John's, NL. to assess the status of the Snow Crab resource in Northwest Atlantic Fisheries Organization (NAFO) Divisions (Divs.) 2HJ3KLNOP4R and Subdivision (Subdiv.) 3Ps. The Terms of Reference, agenda, and list of participants are provided in Appendices I through III, respectively.

Participation included representatives from Fisheries and Oceans Canada (DFO) Science and Fisheries Management Branches (NL Region), the fishing industry, the Provincial Department of Fisheries and Aquaculture, Academia, Aboriginal groups, and other invited experts.

Open discussion took place after each presentation. Summary bullets of the results of the overall Snow Crab assessment as well as the division-by-division assessments were presented, discussed and revised to achieve consensus by the group. These bullets are included in the Science Advisory Report (SAR), which was written and reviewed on March 3-4, 2015.

These proceedings include an abstract and summary of discussion for each presentation. Additional information can be found in the SAR and research documents or from references cited therein.

PRESENTATIONS: ABSTRACTS AND DISCUSSIONS

OCEANOGRAPHIC OVERVIEW: PHYSICAL OCEANOGRAPHIC ENVIRONMENT ON THE NEWFOUNDLAND AND LABRADOR SHELF, UPDATE FOR 2014

E. Colbourne, J. Holden, D. Senciall, W. Bailey, J. Craig and S. Snook

Presenter – E. Colbourne

Abstract

The North Atlantic Oscillation (NAO) Index, an indicator of the direction and intensity of the winter wind field patterns over the North Atlantic, returned to a positive phase in 2014 that was associated with strong arctic air outflow in the northwest Atlantic during the winter months and consequently lower than normal winter air temperatures. Sea ice extent increased substantially during winter 2014 with the first positive anomaly (higher-than-normal extent) observed in 16 years. Annual sea-surface temperatures (SST) based on infrared satellite imagery remained above normal in most areas across the Newfoundland and Labrador Shelves in 2014, however, values have declined from record-high values observed in 2012. The annual bottom (176 m) water temperature at the inshore monitoring station (Station27) was below normal by - 0.6 SD in 2014, a significant decrease from the record high in 2011. The cold-intermediate layer (CIL; volume of < 0°C) in 2014 was at its highest level since 1985 on the Grand Bank during the spring and the highest since 1991 off eastern Newfoundland during the summer. Spring bottom temperatures in 3Ps remained above normal by about + 0.5 SD but were slightly below normal on the Grand Banks by - 0.3 SD. Fall bottom temperatures in 2J and 3K decreased from 2 and 2.7 SD above normal in 2011 to 0.7 and 0.3 above normal in 2014, respectively, a significant decrease in the past 3 years. As a result the area of bottom habitat covered by water < 2°C increased to near-normal values in 2014 during both spring and fall.

Discussion

A participant was asked if a 35-year warming period is considered standard since 1850. The response was that while it may not be considered a significant time series, we are currently experiencing the third observed warming cycle, and the 25-35 years of warming is what is to be expected.

It was then asked if a decreasing bottom temperature over the past three years is to be considered a trend or if it can be attributed to short-term variation. The response was that it is unknown if this is going to amount to a long-term trend, but three years can be considered a trend. It was also pointed out that this winter (2015) does not appear as cold as last winter.

A question was asked regarding broader scale climate patterns, particularly considering that the northeast Atlantic Ocean experienced colder sea surface temperatures (SST), while NL waters (northwestern Atlantic) experienced warmer temperatures (particularly during Summer). The response was that yes, this is possible. It was noted that the broader the spatial scale observed, the larger the variability among regions within that scale. It was also noted that, generally, when the northwest Atlantic is cold there are warm conditions in the northeast Atlantic.

It was then noted that the Atlantic Multi-decadal Oscillation (AMO) is the broadest scale index available and is correlated with the local temperatures addressed in this presentation.

OCEAN PRODUCTIVITY TRENDS ON THE NEWFOUNDLAND AND LABRADOR SHELVES

P. Pepin and G. Maillet
Presenter – P. Pepin

Abstract

Ocean colour satellite imagery and derived metrics indicate changes in the extent and phenology of the spring phytoplankton bloom across the northwest Atlantic which may alter production dynamics and trophic energy transfer. Long-term changes in plankton taxa based on the Continuous Plankton Recorder (CPR) indicate increased standing stocks of phytoplankton but lower levels of cold-water adapted calanoids and certain macro-zooplankton during recent years on the Newfoundland Shelf. Relationships between various plankton stocks based on the CPR Survey and ocean climate conditions suggest further temperature warming may be detrimental to a variety of dominant taxa.

Discussion

It was questioned whether the phytoplankton Spring bloom timing is more important for shrimp than it is for crab. It was also noted that larval hatching of crabs is more regulated by nitrate availability. Therefore, what are the implications associated with change from cold-water to warm-water species, both in calanoid copepods and in hyperiids versus euphausiids? Is *Calanus finmarchicus* more important due to its size, location, and abundance or do arctic species replace them in terms of productivity? The response provided was that *Calanus finmarchicus* accounts for most secondary production on the shelf. The two arctic species contribute mostly to export production, i.e. they are eaten by animals that would eat other zooplankton. It was noted that *C. glacialus* (really an arctic species) does not appear on the shelf for a long duration. Thus its overall impact on the productivity of the system is fairly small. *C. hyperboreus* inhabits mostly deep water and is mostly associated with the outer arm of the Labrador Current. It is more abundant in the deeper offshore waters and is thus less important to the shelf system. Despite all this, *C. hyperboreus* is much larger than *C. glacialus*, thus any

change in its abundance will have an impact on the overall productivity of the region. The arctic species may be declining in abundance but the key player and the species of highest concern is *C. finmarchicus*.

It was noted that euphasiids are more ephemeral and patchily distributed than amphipods. Amphipods are remarkably ubiquitous. They are very abundant just below the thermocline. The NL shelf has never had a high abundance of euphasiids; it does not have the deep holes that are their prime habitat. It was noted that overall productivity is either stable or potentially increasing.

A question was asked (and it was noted that it may be more regarding physical oceanography) regarding near-surface temperature increases due to anthropogenic activities. It was asked if the AMO will start changing as a result of sea surface heating. It was noted that the AMO occurs exactly at the sea surface. Heat is penetrating the water column (sometimes down to 1500-2000 m), particularly in the Labrador Sea. This is where deep convection is normally seen, but that has not been seen as much in the past few years. The difference between climate and weather effects was noted. It was then clarified that the indices presented in the talk deal mostly with weather effects. For instance, cold winters result in increased thickness of the Cold Intermediate Layer. This effect can persist for some time and this year it continued throughout the year. In January, the northern edge of the southeast shoal was warmer, which could be what was left of the summertime warm water that was mixed all the way down to the bottom (~80 m). Weather affects shelf temperatures in the short-term. Climate and weather combined affect temperatures more in the long term.

UPDATE ON DISCARD MORTALITY EXPERIMENTS: SNOW CRAB DISCARD MORTALITY STUDY

W. Coffey, D. Mullowney, D. Fiander, E. Hynick, S. Quilty, and K. Tipple
Presenter – W. Coffey

Abstract

Individual assessments of crab mortality by size, shell condition, and maturity were conducted using two treatments - exposures on deck of thirty and sixty minutes. There was good consistency in pattern and rates of mortality across areas, years, sizes, shell conditions, maturities, and redeployment times. Approximately 70 % of crab survived and were strong; the remainder were either dead or critically weak. Discarding mortality appears to be a concern for even the hardiest of crabs, and although not fully clear, mortality rates are likely very high on soft-shell crabs.

Discussion

A participant commented that in the last few years, crabs are being discarded within about one minute of coming on deck. It was also noted that when crabs are discarded during the fishery, they sink very slowly. This is in contrast with the discard mortality experiments, where crabs are replaced in weighted pots that travel to the bottom quickly.

Regarding the time it took to complete the measurements on deck (30-60 minutes), it was noted that the reason technicians could not do this faster was because they could not measure and tag the crabs in one pot in any less than 20 minutes. It was noted that a study by Scott Grant of the Marine Institute showed that crabs that were discarded quickly did not die. The original intent of the study presented at this meeting was to capture soft shell crabs.

It was noted that if they had caught soft shell crab, the water content in them would have drained off in 30 or 60 minutes on deck. It was also noted that they did attempt to do an

experiment where a fleet of gear came up over the side of the vessel and crabs were transferred quickly to single pots on the stern to be lowered back into the water. The problem was that the single pots floated away and were not retrieved.

DIVISIONS 2HJ3KLNOP4R OVERVIEW

Presenter – E. Dawe

Abstract

Resource status was evaluated throughout NAFO Divs. 2HJ3KLNOP4R based on trends in biomass, recruitment, production, and mortality. Multiple indices of these metrics were derived from a suite of data sources that include dockside-monitored landings, harvester logbooks, at-sea observer monitoring, pre-and post-season trawl surveys, broad-scale post-season trap surveys, localized inshore trap surveys, a vessel monitoring system (VMS), and biological and oceanographic sampling data from multiple sources. The resource was assessed separately for offshore and inshore areas of each NAFO division, where applicable (Divs. 3KLPs). Data availability varied among divisions and between inshore and offshore areas within divisions. Trap and trawl surveys indicate that overall the exploitable biomass has recently declined and Divs. 3LNO now account for most of the biomass. Overall, recruitment has declined in recent years and is expected to decline further in the short term (2-3 years) although it may improve thereafter. The emergence of a pulse of small crabs, associated with cooling oceanographic conditions in the past three years, suggest a modest increase in recruitment within some NAFO divisions in about 6 to 8 years. However, a warm oceanographic regime suggests weak recruitment in the longer term. Trends in indices are described in detail for each division and conclusions are presented with respect to the anticipated effects of short-term changes in removal levels on fishery induced mortality.

Discussion

In regards to the exploitable biomass index (EBI), there was a question regarding the spike that occurred in spring 2012 in Divs. 3LNOP. The response was that this is not necessarily trusted because it did not appear the previous fall, with no fishery in between. It was noted that biomass has barely decreased in the past two years, when looking at the CPS (collaborative post-season) trap survey. It was noted that the bullets from last year stated "little change" while the term "slight decline" could be used this year. It was suggested to only use trap surveys when developing the bullets and also to leave the wording similar to last year's bullets. It was noted that in the previous assessment, the 2013 biomass had increased compared to 2012 and the trap survey data had not shown a decrease for two years in a row, thus the perception is a decrease because 2014 shows low biomass again.

Regarding recruitment, it was asked if the phrase "warm oceanographic regime" is necessary, as it is mentioned in the next bullet. There was discussion on which time frames to use in the bullets (i.e. 2-3 years, 5-8 years, 6-10 years) and what short-term, mid-term, and long-term recruitment mean in terms of numbers of years. It was suggested to not provide commentary regarding recruitment in 5-8 years but this was countered by a suggestion to retain it in order to give some kind of indication of when a recruitment pulse may be expected in the fishery. There was also discussion about whether to use the phrase "warming oceanographic regime" or "broad-scale climate indices." The former was chosen, as it is consistent with terminology in past documents and will be clear for managers.

It was noted that mention of a difference in recruitment among management areas must be included. The total mortality bullet was deleted because participants were not familiar or

comfortable with the calculation of the new index, as it had not been presented in previous assessments.

In a previous discussion it had been suggested to include a 'mid-term prospects' bullet in these overview bullets. There was much discussion on how to do this, as individual divisions and management areas showed variation in when to expect pulses in the next few to several years. It was noted that Subdiv. 3Ps offshore may see a pulse of recruitment in ~3 years, but this is uncertain as it is not known precisely how long it will take for small crabs to grow to legal size, due to biological processes such as skip-molting. It was noted that overall, mid-term prospects are unfavourable except for the Green Bank area in Subdiv. 3Ps. A participant asked about the life expectancy of crab and how would mid-term and long-term prospects relate to the life span of the species? The answer provided was that these predictions do not relate to life span and it has to do with the time it takes small crabs to grow into exploitable biomass (legal sized). It was suggested to use the words "beginning in about five years..." The challenges associated with creating the overall summary bullets, while there is variability among and within divisions, was noted again.

DIVISIONS 2HJ AND SCIENCE ADVISORY REPORT BULLETS

Presenter – D. Mullowney

Abstract

Landings were at their lowest level in two decades in 2013 but increased by 25 % to 1,740 t in 2014. Effort has been at its lowest level in two decades during the last two years and catch per unit of effort (CPUE) has increased since 2012. The exploitable biomass has increased since 2011, as reflected by continued improvement in the post-season trawl survey index. Recruitment has increased since 2011 but short-term (2-3 year) recruitment prospects are uncertain due to variability in the pre-recruit biomass index. The pre-recruit fishing mortality index has increased over the past ten years to above the median level while the exploitation rate index, which increased steadily from 2007-12, has decreased to a moderate level in the past two years. Maintaining the current level of fishery removals would further reduce the exploitation rate in 2015.

Discussion

During the discussion, it was asked if low percent full clutch would affect long-term biomass in Div. 2J. The response was that it is thought that the environment is a bigger driver than is abundance of females or percent full clutch. There were some concerns that if there is a low percent full clutch this means the females were not mated and this could suggest that a low abundance of exploitable males directly leads to a low percent full clutch. It was suggested that this may be something to consider for the precautionary approach. It was noted that female catch rates are always low in these surveys. The dips in percent full clutch in some years could be due to a low sample size in those years. Additionally, it was noted that in the past five years, female abundance indices remained very low, while the percent full clutch remained high. It was also noted that by comparing the three dips observed in percent full clutch with mature female abundance indices, it appears that increases (spikes) in mature female abundance indices (which occurred in 1997, 2003, and 2008) precede decreases (dips) in percent full clutch by about two years. It was then asked if this means that increases in mature female abundances are leading to dips in percent full clutch a few years later? The response was that this has not been a focus but is a good observation. It is believed the dips in percent full clutch are due to small sample size.

It was noted that CPUE increased in 2014 before biomass increased and that it is better to fish a good biomass over more than one year. There was also a question regarding whether or not the fishery is saturated. The answer provided was that the leveling off of CPUE vs. exploitable biomass could perhaps be due to trap saturation. This index could still be reliable if the relationship only levels off at its maximum trap saturation.

Regarding CPUE, there was discussion on whether or not the Total Allowable Catch (TAC) is at a sustainable level and it is hoped that it is. The large decrease in effort over the past few years was attributed to abandoning the fishery in 2H (Cartwright Channel) early in the season due to incidence of soft shell. It was noted that VMS data showed an increase in CPUE in 2014 and other indices (observer and logbook) showed a decrease. The response was that it is not necessary to choose one index as they both tell similar stories: highs in the last two years. For example, VMS data show a low in 2013, while observer and logbook indices show a high in 2013. Regardless, the overall trend is high CPUE in the last two years.

Regarding exploitable biomass, it was asked to provide an explanation for citing one survey (trawl) over another. It was noted that this will be explained in the text of the SAR. It was also noted that last year the trawl survey was chosen for consistency between years. Regarding recruitment prospects, it was noted that an increase in exploitable biomass may not be predicted based on a poor year of pre-recruits. The answer was that, except for a year effect in 2013, there has been a gradual increase in pre-recruit abundance in the last few years that could result in an increase of exploitable biomass.

There was discussion about whether the substantial reduction of effort in the years 2011-13, may have been related to a large increase in soft shell. There was discussion about OGMAP (OGive MAPping) estimates of pre-recruit abundance. The response to the question: "why state that a decline is expected if prospects are uncertain" was that this is due to pre-recruit: exploitable biomass ratios and factors relating to ocean climate. It was asked why a pulse may come in 2019-20. The response was that recruitment has increased since 2011 and ocean climate may be creating more favourable crab conditions. In addition, there were some small crabs observed that may recruit to the fishery in those years, plus the ratio of exploitable biomass to pre-recruits is increasing. It was noted that the time it takes for recruitment to become exploitable biomass is usually two years. It was asked where the increase last year in exploitable biomass came from without evidence from pre-recruits in previous years.

It was then suggested that perhaps pre-recruitment is not the best evidence. It was noted that pre-recruitment in three of the last four years was above the median index. The mean may be misleadingly high when the index has a quotient with a very low denominator.

It was asked if mortality can be considered at a 'relatively low level' compared to the past ten years if it is, in fact, above the median level? There was discussion about the importance of discussing mortality indices. There was a level of discomfort about some participants' understanding of the calculations that went into creating mortality index (Z). It was asked if managers needed to know about mortality. This was not fully resolved during this discussion and it was stated that it would be reconsidered in future assessments, after participants had time to review and discuss the new methodology.

It was suggested to remove prospects in 2019-20 since management decisions do not need to be made for those years at this time. It was noted that what is most important is what needs to be done for the 2015 season.

It was asked if consideration should be given to taking a five year average of the exploitation rate index (ERI) in order to compare current levels with the past five years. It was noted that

detail may be lost when doing this as most crabs grow to legal size and do not live for five years. It was also noted that even though ERI is at moderate levels, it is still fairly significant.

SUBDIVISION 3PS OFFSHORE AND SCIENCE ADVISORY REPORT BULLETS

Presenter – E. Dawe

Abstract

Landings declined from a peak of 4200 t in 2011 to 2700 t in 2014, while TACs have not been taken although effort has increased to a record high level. CPUE has steadily declined since 2009 to a record low in 2014. The exploitable biomass, as indicated by the sprir.g trawl and fall trap survey indices, has been at its lowest level during the past two years. Both trap and trawl surveys indicate recruitment has declined since 2009. Recruitment is expected to remain low in the short term (2-3 years) as pre-recruit biomass indices from both trap and trawl surveys declined rapidly from 2009 to their lowest levels in 2013-14. The exploitation rate index has been at or near its highest level during the past two years and the pre-recruit fishing mortality index has increased steadily since 2010 to its highest level in 2014. Maintaining the current level of fishery removals would result in a continued high exploitation rate in 2015.

Discussion

Regarding the decline in CPUE since 2009, it was asked if it should be specified that this is supported by all three indices of CPUE (logbook, observer, and VMS data). It was decided to just mention CPUE in general and leave out mention of the agreement among the three indices.

It was pointed out that both trawl and trap surveys show a decline in recruitment, as evidenced by biomass of new shell, legal sized crabs, since 2009.

Regarding short-term recruitment prospects, it was noted that there is variability in predictions as there is variability in pre-recruit biomass among survey types. The pre-recruit biomass indices from trawl and trap surveys declined rapidly from 2009 to reach their lowest levels in 2013-14. However, three to four years ago, post-season small mesh trap surveys showed a pulse of very small crabs, which could represent a contribution to pre-recruitment next year and/ or exploitable biomass the following year. It was also noted that a portion of those small crabs were terminally molted and thus would not grow to legal size and contribute to the exploitable biomass. It was decided not to include a bullet on total mortality in the final document, for the same reasons described in the overview section.

Longer-term prospects are uncertain. It was agreed that a bullet addressing mid-term prospects would be provided in the overview bullets of the SAR. It was questioned if the ERI actually doubled between 2012 and 2013. It was explained that the biomass index from the 2013 trawl survey was low and then slightly increased in 2014, corresponding with the finding of a much higher ERI in 2013. It was noted that bullets developed in previous years mentioned the percent discarded, and participants were asked if they thought it should be discussed or if the mortality indices newly developed this year should be left in. There was little discussion in this regard.

SUBDIVISION 3PS INSHORE AND SCIENCE ADVISORY REPORT BULLETS

Presenter – E. Dawe

Abstract

Landings remained at 2,500 t from 2011-13 but decreased to 2,200 t in 2014, even though effort has increased steadily since 2010. CPUE remained at a high level from 2010-12 but has declined sharply in the past two years. The exploitable biomass, as indicated by the post-

season trap survey index, declined since 2012 to its lowest level in eight years. Recruitment declined substantially in the past two years to its lowest level. Recruitment is expected to remain low for at least 2-3 years as the pre-recruit biomass index declined by more than half from 2007-11 and has since changed little. The post-season trap survey-based exploitation rate index changed little from 2008-13 but nearly doubled in 2014. Data are insufficient to estimate a pre-recruit fishing mortality index. Maintaining the current level of fishery removals would result in an increase in the exploitation rate in 2015.

Discussion

An effort statement was added to the landings bullet. It was asked if it would be more appropriate to discuss Subdiv. 3Ps inshore as a whole (rather than separating three Crab Management Areas (CMAs), and note that trends are driven by CMA 10A (Placentia Bay). It was suggested that mention of individual CMAs could be left out of bullets but could be described how they differ elsewhere in the SAR. A participant questioned the logic for not specifying Placentia Bay in the bullets, and the response was that it is for conciseness and that in the other divisions CMAs are never specified, as there are too many to mention in a bullet.

Regarding exploitable biomass, it was decided to use the wording "has declined" rather than quantify it with "two-thirds." Regarding recruitment, it was asked if the words "declined to its lowest level" meant lowest level ever. The response was no, and that it was similar to recruitment in 2004. Regarding recruitment prospects, it was questioned why recruitment prospects are not stated to be low for four to five years instead of two to three years. It was answered that prospects in four to five years are uncertain due to possible spillover of biomass from Div. 3O within that time frame.

DIVISION 3K OFFSHORE AND SCIENCE ADVISORY REPORT BULLETS

Presenter – E. Dawe

Abstract

Landings declined by half since 2009 to 6,100 t in 2014, their lowest level in two decades, while effort has declined by a third. CPUE declined by half from 2008 to 2011 and has since changed little, remaining near a historic low level. The post-season trawl and trap survey exploitable biomass indices have both declined steadily since 2008 to be at or near their lowest levels. Recruitment has been poor since 2009 and is expected to remain low in the short term (2-3 years) as the post-season trawl and trap survey pre-recruit biomass indices have both declined since 2008 to their lowest levels. The pre-recruit fishing mortality index has varied at a moderate level since 2009. The exploitation rate index increased from 2008-10 and has since changed little. Maintaining the current level of fishery removals would result in a continued high exploitation rate in 2015.

Discussion

During the presentation, there was discussion around figure-labeling, whereby a participant noted that it was not explicit enough and led to confusion as to whether the figures were addressing pre-recruit biomass or recruit biomass. It was suggested that in future presentations the figures should be labeled more specifically.

OGMAP was explained as an alternative method to STRAP (STratified Random Assessment Process) analysis, where confidence limits will never be below zero (as is the case with STRAP). The statistical assumptions employed by OGMAP avoid the possibility of having negative confidence limits. The differences between the two methods for estimating exploitable biomass in 2013 for this area were by a factor of two and this has not yet been investigated.

Regarding landings, it was decided to quantify how much effort has declined since 2009.

In discussions on the CPUE, it was noted that the wording "remaining near a historic low level" was chosen because CPUE in 2014 was near levels observed in 2004, but values remain technically higher than in some years.

Regarding recruitment biomass, as determined using trap survey data, it was decided that the words "since 2009" are correct, as "since" refers to the beginning of change.

A participant asked if a bullet describing medium-term recruitment prospects should be included or if the wording "two to three years" should be used consistently among bullet sections for all divisions. The latter option was agreed upon as it is the most accurate prediction given the available data, and also is the most relevant to managers.

It was explained that the idea was to indicate that ERI has been relatively high for a number of years and the increase between 2008 and 2010 was chosen as a good reference point.

Regarding EBI, there was some discussion as to whether or not EBI is decreasing or is remaining at a low level. This is because both the trap and trawl surveys showed a decrease in EBI between 2013 and 2014, however the magnitude of change was larger with the trap survey. It was decided to use the terminology "at or near their lowest levels" for both indices. This affects the prediction for the 2015 exploitation rate, as the interpretation of a decrease in EBI would result in an increase in exploitation rate. It was decided that the magnitude of change in EBI is not large enough to predict an increase in exploitation rate for 2015 and the wording "continued high exploitation rate in 2015" was chosen for the bullet.

DIVISION 3K INSHORE AND SCIENCE ADVISORY REPORT BULLETS

Presenter – E. Dawe

Abstract

Landings declined from 2,900 t in 2009 to 1,750 t in 2014, due to declines in CMA 3D (Notre Dame Bay) and 3C (Green Bay) where TACs were not taken in most of the past 5 years. Overall, effort has declined since 2011. CPUE has remained low during the past four years in CMAs 3C and 3D, whereas it remained high in CMA 3B (White Bay). The CPS trap surveys indicate that the exploitable biomass has remained low in CMAs 3C and 3D in the past 4 years and the DFO trap survey indicates the exploitable biomass in CMA 3B has remained high. Recruitment has been low during the past 3-4 years in CMAs 3C and 3D, while in CMA 3B, it peaked to its highest level in 2012 but has since declined. Recruitment is expected to remain low in the short term in CMAs 3C and 3D and to continue to decline in CMA 3B. In the last two years, the post-season trap survey-based exploitation rate index has changed little in CMA 3D, has declined in 3B, and has increased sharply in 3C. Data are insufficient to estimate the pre-recruit fishing mortality index. Maintaining the current level of fishery removals would likely result in little change in the exploitation rate overall in 2015 with continued high exploitation in CMA 3C.

Discussion

During the presentation it was noted that exploitable biomass may not be as low as the figure presented suggests. When looking at exploitable biomass recruitment figures, there was a question to clarify whether or not the figures show only legal sized crab (the answer was yes). When soft shell information was presented a participant noted that seasonality could affect the results, as soft shell crab are expected later in the season.

During discussions, it was asked if CMAs 3C and 3D belong in an offshore assessment. It was noted that yes, biologically this is true, but that trawl surveys do not come into these areas. It was noted that nevertheless, this should be considered for next year. It was also noted there is a problem from a management perspective in that managers want advice on their areas, but the areas do not fit together properly (in terms of population and fishery trends).

A general trend in the ensuing discussion was surrounding the issue of making overall statements for the division based on CMAs that show very different trends in fishery performance and biology.

Regarding effort, it was noted that effort in 3B has not changed and so it cannot be stated that effort has declined since 2011. Prefacing the statement with the word "overall" in order to capture the general trend for the division ameliorated the problem.

It was asked if CPUE should really be considered low, as it appears to be about average for the dataset (beginning in 1990). It was suggested that a running average be presented in the figures, but it was explained that this was once the practice but it was decided a few years ago to remove it. It was also asked if CPUE was low relative to other areas. The answer was that the statement refers to being low compared with previous years within the same CMA. It was suggested to use descriptive text such as "relatively segregated" when describing White Bay (CMA 3B), however this was countered by the statement that those types of text are not useful for anyone who has not taken part in the discussion. Thus it was decided to exclude descriptive text such as "relatively segregated" from the bullet.

It was noted that bar graphs generated from CPS trap survey data were normally shown in previous SARs, but in this case they are not necessarily trusted for White Bay, specifically for the year 2014. There was also discussion about what year the decline in exploitable biomass

began. It was then re-iterated that the 2014 EBI from the CPS trap survey data is not trusted, based on the high EBI found during the DFO trap survey in White Bay (the data were presented segregated among depth strata) in 2014. It was then suggested to create individual bullets for each survey used and, if so, the CPS and DFO surveys would have to be explained in the overview data sources bullet.

Regarding recruitment, there was discussion on how to interpret the trend in new shelled (legal sized) recruits in White Bay. The trend is not very clear and was described as having a spike in 2012, followed by a dip in 2013, followed by a marginal increase in 2014. It was asked if everyone was comfortable with saying there was a decline in recruitment. It was noted that the spike in 2012 was likely accurate as a high occurrence of soft shell in 2010 caused early abandonment of the fishery in that year.

A participant noted that the recruitment prospects in CMA 3D do not appear to be low in 2014. It was clarified that the value is still lower than a peak observed in 2010.

Regarding ERI, it was noted that all three CMAs discussed have shown different trends in ERI: it has decreased in 3B; increased in 3C; and it has not changed in 3D. It was noted that aside from a spike in 2012, ERI has been oscillating downward in CMA 3B and could even be at its lowest level in the last two years, while the increasing ERI in CMA 3C is of concern. It was asked if it is acceptable that DFO survey data is used to calculate exploitable biomass while CPS survey data is used to calculate ERI. The response was that this is not a problem now but will become a problem for next year. It was decided to just mention "in the last two years" in the bullet.

DIVISION 3LNO OFFSHORE AND SCIENCE ADVISORY REPORT BULLETS

Presenter – D. Mullowney

Abstract

Landings have remained near their highest level, at about 26,000 t, in the past 3 years. Effort declined considerably from 2011-13 but increased slightly in 2014. CPUE increased from 2009-13 and changed little in 2014. The indices of exploitable biomass from spring and fall trawl and trap surveys decreased, to differing degrees, in 2014. Recruitment has declined since 2012 and is expected to decline further in the short term (2-3 years) as the pre-recruit biomass indices spring and fall trawl and trap surveys have declined since 2010. The exploitation rate index has changed little over the last four years and the pre-recruit fishing mortality index has remained relatively low since 2008. Maintaining the current level of fishery removals would likely increase the exploitation rate in 2015.

Discussion

There was concern that the uncertainty associated with using three different indices to calculate biomass meant that no definitive conclusions should be used.

There was some discussion about how mortality could decrease in a scenario with constant catch and a decrease in biomass. It was asked if there was an artifact in the way mortality (Z) was calculated. The response was that the artifact is the higher residual biomass (i.e. if the amount of crabs reaching old age increases the amount of death decreases). It was noted that the shell condition is not taken into account when calculating the mortality index, thus the index is subject to variations in shell condition.

It was noted that if there is a management area within a division showing a positive increase (in exploitable biomass), it should not be excluded (from the summary bullets) as it affects the

fishers in the area. It was stated that the differences among management areas will be included in the SAR, while the bullets are meant for an overall summary.

When discussing discard rates, it was noted that the discard rate has been decreasing because soak times have increased. It was also noted that the number of traps per license has increased from 800 to 1200 and there have been more efforts such as combining enterprises, which result in less hauling, giving crab more time to 'sort on the bottom' (i.e. longer soak times allow more time for small crabs to crawl out of the pots), which in turn results in less time sorting on deck. From a harvesting perspective, it was suggested that having more pots per license is a big help to decrease crab handling and keep discard numbers down.

DIVISION 3L INSHORE AND SCIENCE ADVISORY REPORT BULLETS

Presenter – D. Mullowney

Abstract

Landings have increased gradually since 2010 to a historical high of 8,000 t in 2014 while overall effort has declined. CPUE has been near its highest level for the past three years but there has been considerable variability among management areas. The post-season trap survey index suggests the overall exploitable biomass has increased steadily since 2008 to its highest level in the time series. Most management areas have experienced increases in recent years. Overall recruitment has declined gradually since 2010, although there is considerable variability among management areas. Recruitment is expected to decline further in the short-term (2-3 years) as the post-season trap survey pre-recruit biomass index decreased in the past two years. The post-season trap survey-based exploitation rate index has changed little over the time series, with considerable variability among management areas. Data are insufficient to estimate a pre-recruit fishing mortality index. Maintaining the current level of fishery removals would likely decrease the exploitation rate in 2015.

Discussion

During the presentation it was asked how recruitment could be low during the last three or four years, while biomass is increasing. The response was that there is a declining rate of recruitment but that is matched by a declining rate of mortality. It was also noted that even though recruitment is declining, recruitment to the fishery is still occurring. During bullet-writing, there was discussion about variability in exploitable biomass among management areas. CMA 8A is the only CMA where there is a decrease in exploitable biomass.

When discussing recruitment prospects, it was noted that a percentage of pre-recruit-sized crabs are actually adults (have terminally molted) and so do not truly represent pre-recruitment to the fishery. This led to discussion regarding the possibility to measure claws (to determine whether or not crabs have terminally molted) during the CPS survey. It was noted that when observers first began sampling crabs, this was attempted, but there was a high level of error due to the high level of accuracy required. Currently, samples from small mesh pots are sent to a lab at DFO for measurements. It was suggested that only well-trained, experienced observers could be expected to do these measurements accurately. There was a point made that there may not be time to measure the claws during the survey. It was also noted that fishers are required to help in the sampling or else the CPS will not work. It was agreed that a research objective will be to start measuring claws during the CPS survey.

DIVISION 4R OFFSHORE AND SCIENCE ADVISORY REPORT BULLETS

Presenter – D. Mullowney

Abstract

Data were insufficient to assess resource status in Offshore Div. 4R. Therefore, the effect of maintaining the current level of removals on the exploitation rate in 2014 is unknown.

Discussion

Div. 4R (offshore) was grouped with 4R inshore for the presentation. Data are insufficient to provide summary bullets for 4R offshore. This is because there are no observers in the area and the trap survey in the area was not well done over the past few years. It was also noted that the effort in the offshore fishery is concentrated very near the inshore line.

DIVISION 4R INSHORE AND SCIENCE ADVISORY REPORT BULLETS

Presenter – D. Mullowney

Abstract

Landings have increased from a historical low of 155 t in 2010 to about 600 t in 2013-14. Effort has been stable for the last three years. CPUE has been near an all-time high for the last three years. The exploitable biomass index peaked in 2011 and has since declined to its previous level. Recruitment has declined since 2011 to its lowest level and recruitment prospects are unfavourable in the short term (2-3 years). The trap survey index of pre-recruit-sized males peaked in 2009 and has since declined to its lowest level. The post-season trap survey-based exploitation rate index decreased in 2012 and has since changed little. Data are insufficient to estimate a pre-recruit fishing mortality index. Maintaining the current level of fishery removals would result in an increase in the exploitation rate in 2015.

Discussion

Regarding landings, it was noted that the 2013 landings reported previously were 190 t, but in this year's bullets it is reported as 155 t. After checking on this it was determined that 155 t is correct. It was also noted that the TAC has been almost taken for the past three years. There was not much discussion regarding any bullets until the last bullet (stating exploitation rate prospects for 2015) where it was suggested to remove the term 'likely' as it is implied when writing bullets based on indices. It was pointed out that the table showing raw CPUE values throughout the time series does not show the same information as in the CPUE figure. It was noted that the figure is correct and the difference between the two information sources will be investigated.

A SPATIO-TEMPORAL DEPLETION MODEL FOR SNOW CRAB IN NEWFOUNDLAND AND LABRADOR, BASED ON COMMERCIAL CATCH AND EFFORT

N. Cadigan, J. Fisher, D. Mullowney and E. Dawe

Presenter – N. Cadigan

Abstract

Fish stock size declines throughout the fishing season as fishery catches increase and this relationship can sometimes be used to estimate stock size based on the rate of decline in a CPUE time-series. However, this decline can also be affected by changes in the spatial distribution of the fishing fleet. A spatio-temporal depletion model that adjusts for bias caused

by changes in the fleet distribution is proposed. This model is applied to data from 2000-12 to estimate stock size and fishery exploitation rates for NL snow crab fishery. The model is applied to commercial catch and effort data from 9 assessment regions: 2HJ, 3K inshore and offshore, 3L inshore, 3LNO offshore, 3Ps inshore and offshore, and 4R inshore and offshore. Various model configurations are compared to assess the robustness of the approach.

Discussion

There was much discussion regarding calculation and use of the term 'q', which represents trap 'catchability'. In other words, it is the effective area fished by a single trap. There was also much discussion about how or why q has changed from year to year – it is supposed to be a constant. It was noted that the original intent of creating a spatial depletion model was to compare and contrast results obtained by the trawl with logbook results. It was noted that poor logbook return has negatively affected the use of this model. It was also noted that for small inshore fleets, the logbook may report one position, but they may have fished multiple sets in different areas surrounding the reported position. It was asked if these fishers would likely move outside a 10x10 km cell, with the response that inshore this is unlikely, but offshore it is much more likely.

It was noted that when thinking about individual grid cells, it is assumed that crab mixing is infinite within a cell and zero between, and that the fleet distributes randomly within a grid cell. There was concern about the lack of understanding associated with the model. It was stated that if one does not understand the reason that q has changed from year to year, that the model should not be used for advice. This was countered as perhaps over-emphasizing the flaws of the model.

It was asked if 'better' fishers tend to catch quotas early in the season and then stop fishing, which could be a factor leading to a decrease in CPUE during the season. The response was that the ability of individual fishers probably does not affect overall fishery performance as the fishery is heavily reliant on technology (i.e. boats, pots). It was also pointed out that bigger boats are able to have more pots and fish earlier in the season when there are more instances of bad weather, while smaller boats do not have these advantages.

It was asked why the model does not take recruitment into account to make up for some mortality. The response was that the model starts in January and ends in August and therefore is not affected by recruitment (which occurs in the fall). It was asked how the model deals with the issue of very little fishing effort in the first weeks of the season. It was answered that the model fits the CPUE in a grid cell and when there is little fishing effort in the first weeks of the season then this only affects a few grid cells where the fishing occurred and does not affect other grids cells that haven't been fished yet.

There was a comment on the effects of crab behaviour. It was noted that it is interesting that Divs. 3LNO had the lowest 'q' and 4R had the highest. Div. 4R is believed to be the division supporting the lowest crab densities. Thus some observations could reflect behaviour. It was also noted that different trap spacing could be occurring in Divs. 3L and 3K. It was noted that there are studies that show area fished by a trap can be estimated by setting parallel traps with different trap spacings and based on the asymptote of the catch by trap spacing relationship, one is able to achieve an estimate of the effective area fished. It was noted that this could be interesting research to perform in collaboration with commercial fishers. It was stated that optimum spacing between pots is approximately 35 fathoms. But some fishers use only about 16 fathoms and get good catches. This indicates that CPUE is not linearly related to biomass. It was noted that the issue of 'q' in the trap is no different that issues faced with STRAP, where the protocol may be fine but the output may not be.

PROGRESS ON PRECAUTIONARY APPROACH REFERENCE POINTS AND HARVEST CONTROL RULES

Presenter – D. Mullowney

Abstract

No abstract required/provided.

Discussion

The precautionary approach (PA) discussion was based on determining a useful reference point to indicate when the stock is in 'serious harm' in order to satisfy the Marine Stewardship Council's (MSC) requirements for a sustainable fishery. There is a working group to that effect. For the 2015 peer review (two years into MSC certification), the goal was to propose precautionary reference points.

The method presented was to use percent full clutch (the percentage of the female population carrying a full clutch of eggs) as a potential indicator, with 80% arbitrarily chosen as a reference point. PA would come into play when, in two years in a row, ≤ 80% of females carried full clutches. A relationship between percent full clutch and exploitable biomass is assumed. This is called a stock-recruitment relationship. It assumes that exploitable biomass and percent full clutch are related such that in years with high percent full clutch, high exploitable biomass should follow eight years later (the time it takes for the eggs hatched from the clutch to achieve legal size). Likewise, it assumes that high exploitable biomass (large males) would result in a high percent full clutch (having been fertilized by the large males). However, there is no indication in the data that exploitable biomass and percent full clutch are related in terms of a stock recruitment relationship.

Discussion followed about whether or not percent full clutch related to exploitable male biomass is an appropriate indicator of serious harm. One suggestion was to follow the management currently used in the Bering Sea, which is a mature male biomass (MMB) instead of an exploitable male biomass. Mature males < 95 mm are included in MMB. It was noted that soft shell incidence has been used as an indicator of fishery harm, because more soft shell crabs are trapped when there are fewer exploitable males. This was determined only to be a fishery concern and not relevant to effects on reproductive potential or the precautionary approach. It was asked that if the biology changed such that current management measures were no longer effective, how would anyone know? It was pointed out that it is a fortunate situation to be involved with a fishery that is in a good condition and has not experienced serious harm.

It was noted that there are twenty five management measures in place already, which was suggested to indicate that the fishery is already managed with PA in mind. It was asked if yield per recruit could be related to PA. It was noted that a PA is put in place for long-term fishery benefits. It was stated that there is a maximum sustainable yield clause for management. A participant inquired about the status of the Integrated Fisheries Management Plan and it was noted that it was updated this year but has not yet been made public. It was asked if spatial distributions of percent full clutch in concurrence with occurrence of mature males could be considered.

The general consensus was that there are limits to a way forward for determining reference points. This is simply because there are no data that appear to limit recruitment. The data available from trawl surveys are limited due to low catchability. It also seems unlikely that a relationship between exploitable biomass and percent full clutch will be found. None of the participants have seen a Snow Crab fishery that is in serious harm and therefore do not know how to identify it. It was agreed that other potential indices such as the MMB will be discussed,

along with continued investigation of percent full clutch. It was noted that the concept of yield per recruit will also be considered, especially as a candidate harvest control rule, however, there was concern for quantification and application for management purposes. It was stated that the working group will meet again to discuss PA and reference points.

RESEARCH RECOMMENDATIONS

- An analysis of shell-age composition that is focused specifically on survey data from highly fished areas to look for evidence of fishery-induced effect.
- Investigate new ageing methodology (gastric mill).
- Investigate development of total mortality estimates based on survey shell condition data.
- Investigate the exact mechanisms in snow crabs that generate trap saturation.
- Examine Campelen survey behaviour on different substrates. This may occur by testing whether snow crabs in trap surveys have a catchability independent of bottom type. Follow this with nearest neighbor analysis of trap versus Campelen trawl and how it is affected by bottom type. (Compare NL Campelen and Gulf Nephrops trawls).
- Investigate a comparison of existing CPS survey gear with weighted pots equipped with bait protectors in areas of strong currents.
- Consider changes to the existing CPS survey to better understand trends in adolescents vs. adults (e.g. measuring claws, reviewing small mesh trap deployment, increase sample size).
- To fulfil MSC certification requirements, explore MMB (Mature Male Biomass) as an indicator of mating success and larval production. Also, investigate the relationship of percent full clutches and co-occurrence of mature males.

APPENDIX I: TERMS OF REFERENCE

Newfoundland and Labrador Snow Crab Assessment

Regional Peer Review Process - Newfoundland and Labrador Region

February 24–27, 2015

St. John's, NL

March 3 5, 2015 [1]

St. John's, NL

Chairperson: Mark Simpson

Context

The status of Div. 2HJ3KLNO, Subdiv. 3Ps and Div. 4R Snow Crab was assessed in 2014. The current assessment of the stock components was requested by Fisheries Management to provide current information on the status of the resource and to provide the data that will be used in the 2015 Snow Crab Management Plan.

Objectives

- To assess the status of snow crab resource: Divs. 2HJ3KLNOP4R;
- To determine the impact of maintaining the current harvest levels; and
- To provide status updates on the Precautionary Approach (PA) framework reference points and harvest control rules.

Expected Publications

- Science Advisory Report
- Meeting Proceedings
- Research Document

Participation

- Fisheries and Oceans Canada (DFO) Science and Fisheries Management
- Province of Newfoundland and Labrador Department of Fisheries and Aquaculture
- Academia
- Aboriginal Groups
- Fishing Industry
- Other invited experts

[1] March 3-5 will be used to finalize the complete text of the Science Advisory Report. All attendees are invited to participate. Summary bullets for each stock will be agreed upon in plenary during the February 24-27, 2015 meeting.

APPENDIX II: AGENDA

AGENDA

Newfoundland and Labrador Regional Peer Review Meeting:

Assessment of Snow Crab

Hampton Inn and Suites

St. John's, Newfoundland & Labrador

February 24-26, 2015

Northwest Atlantic Fisheries Centre, 80 East White Hills Road

St. John's, Newfoundland & Labrador

March 3-5, 2015

Chair: Mark Simpson

Tuesday, February 24

Time	Activity	Presenter
0900	Preliminaries and greetings from the Chair	Mark Simpson
0915	Oceanographic Overview	Eugene Colbourne
0945	Ocean Productivity Trends on the Newfoundland and Labrador Shelves	Pierre Pepin
1015	Update on Discard Mortality Experiments	Will Coffey
1030	*BREAK*	N/A
1045	Divisions 2HJ3KLNOP4R Overview and Science Advisory Report Bullets	Earl Dawe
1115	Divisions 2HJ and Science Advisory Report Bullets	Darrell Mullowney
1215	*LUNCH (not provided)*	N/A
1315	Subdivision 3Ps Inshore and Science Advisory Report Bullets	Earl Dawe
1500	*BREAK*	N/A
1515	Subdivision 3Ps Offshore and Science Advisory Report Bullets	Earl Dawe
1700	*ADJOURN*	N/A

Wednesday, February 25

Time	Activity	Presenter
0900	Division 3K Inshore and Science Advisory Report Bullets	Earl Dawe
1030	*BREAK*	N/A
1045	Division 3K Offshore and Science Advisory Report Bullets	Earl Dawe
1200	*LUNCH (not provided)*	N/A
1300	Divisions 3LNO Inshore and Science Advisory Report Bullets	Darrell Mullowney
1500	*BREAK*	N/A
1515	Divisions 3LNO Offshore and Science Advisory Report Bullets	Darrell Mullowney
1700	*ADJOURN*	N/A

Thursday, February 26

Time	Activity	Presenter
0900	Division 4R Inshore & Offshore and Science Advisory Report Bullets	Darrell Mullowney
1030	*BREAK*	N/A
1045	A spatial depletion model for NL snow crab	Noel Cadigan
1200	*LUNCH (not provided)*	N/A
1300	Progress on Precautionary Approach reference points and harvest control rules	ALL
1500	*BREAK*	N/A
1515	Research Recommendations	ALL
1700	*ADJOURN*	N/A

APPENDIX III: LIST OF PARTICIPANTS

Name	Affiliation
Mark Simpson	DFO-Science
Phil Barnes	Fogo Island Co-op
Annette Rumbolt	DFO-RM
Eugene Colbourne	DFO- Science
Loyola Sullivan	Ocean Choice Int'l
Gilbert Penney	FFAW
Wayne King	DFO-RM
Laurie Hawkins	DFO-RM
Ray Dalley	Quin-Sea Fisheries
Dave Senciall	DFO-Science
Darlene Fiander	DFO-Science
William Coffey	DFO-Science
Katherine Skanes	DFO-Science
Earl Dawe	DFO-Science
Edgar Coffey	Quin-Sea Fisheries
Jane Tucker	MUN
Jim Meade	DFO-CSA
Don Stansbury	DFO-Science
Darrell Mullowney	DFO-Science
Nancy Pond	NL-DFA
Noel Cadigan	CFER
Pierre Pepin	DFO-Science
Derek Butler	ASP
Karl Sullivan	Barry Group
Geoff Evans	DFO-Science
Peter Shelton	DFO-Science
Todd Broomfield	Nunatsiavut Government
John Furlong	Seawatch
Pete Crocker	Torngat Fish Co-op
Keith Watts	Torngat Fish Co-op

Name	Affiliation
Albert Wells	Inshore Council
Eldred Woodford	3K Harvester
Perry Collins	3K Fisher
Monty Way	FFAW
Rick Kean	3K Fisher
Erin Carruthers	FFAW
Julie Whalen	Torngat Secretariat
Claude Rumbolt	Fishery Consultant
Erin Dunne	DFO-RM
Darren Sullivan	DFO Science
Tony Doyle	Fisher 6B
David Bonnell	Torngat Joint Fisheries Board
Andy Careen	FFAW
Kevin Hurley	DFO-RM
Corey Morris	DFO-Science
Brian J. Careen	Fisher 3Ps Inshore-10A
Aubrey Payne	FFAW
Dave Orr	DFO-Science
Pete Goulet	DFO-Science
Sara Lewis	DFO-Science
Chris Butler	Quinn-Sea
Surendra Botlagunta	CapeBroyle Sea Products
Stelman Letto	Conche Seafoods
Ken Budden	Fogo Island Co-op
Lorne Porter	Fisher 3L
Henry Thorne	Fisher 3L
Andrew Daley	Fisher 3L
Leon King	DFO
Jon Fisher	CFER-MI